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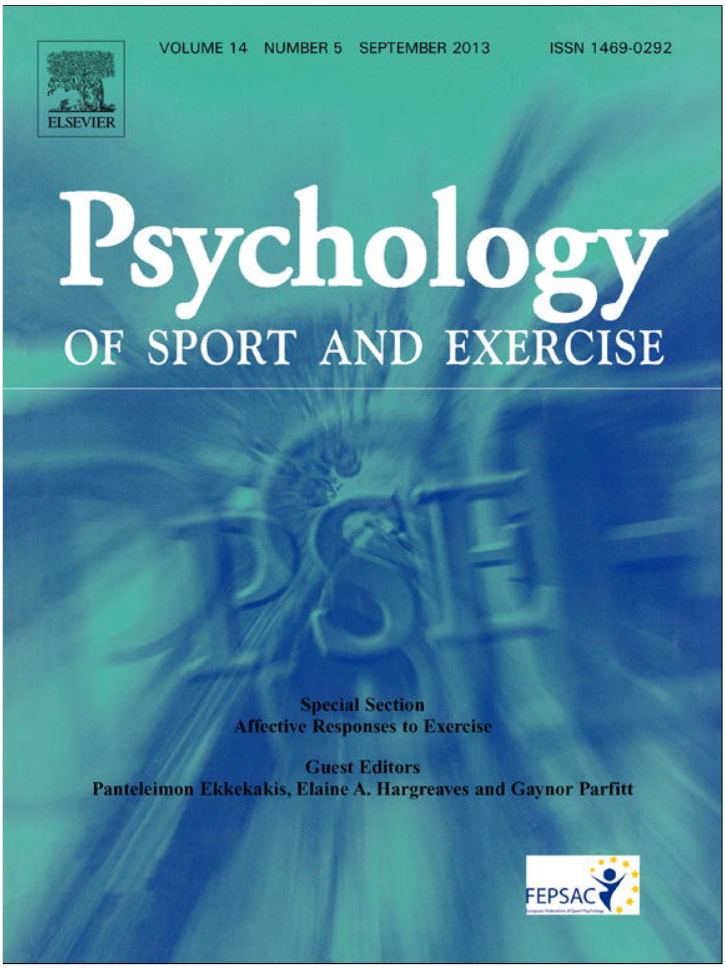

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Psychological need-satisfaction, and basketball performance

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ABSTRACT

Objectives: We applied self-determination theory (Deci & Ryan, 2000) to examine whether pre-game psychological need-satisfaction predicts the quality of sports performance, and whether performance, in turn, predicts post-game need-satisfaction.
Design/method: Undergraduate participants competing in a recreational league basketball season completed autonomy, competence, and relatedness need-satisfaction measures before and after games ($N = 150$ person-games). For each game, data were collected on the number of one, two, and three point shots taken, as well as shooting percentages for each type of shot.
Results: Participants with greater pre-game autonomy performed best overall during games, although this pattern did not emerge within-subjects. Good game performance predicted enhanced post-game relatedness and competence, both between- and within-subjects.
Conclusion: Implications for optimal sports performance are considered.
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Understanding and enhancing sports performance is an important goal for sports psychologists, coaches, trainers, and athletes themselves. Considerable research has focused on the prior psychological state of the athlete as a predictor of subsequent sport performance, finding effects of factors such as confidence (Gayton & Nickless, 1987; Smith & Christensen, 1995), relaxation (Jones, Mace, & Williams, 2000), self-efficacy and positive expectancies (Martin & Gill, 1995; Wurtele, 1986), sense of control (Otten, 2009), flow (Schuler & Brunner, 2009), and achievement motivation (Smith & Christensen, 1995). We followed in this tradition but used a somewhat new approach by measuring players' state of psychological need satisfaction before every game. If a player's psychological needs are better satisfied before games, is that player able to deliver an objectively better performance during games?

Psychological needs

As seen above, many different kinds of prior psychological states have been examined as predictors of subsequent sports performance. In order to systematize this research it would be useful to be able to identify and classify "core psychological experiences" that people need in order to thrive. Such a unified theory would enable sport performance researchers to systematically evaluate and compare the influence of various states upon performance. In this research we drew upon psychological need concepts, which are at the heart of self-determination theory (SDT: Deci & Ryan, 1985, 2000; Ryan & Deci, 2008). According to SDT, psychological needs are "experiential nutriments" (Ryan, 1995) or experiences and feelings that all people require in order to grow, be happy, and thrive. Specifically, SDT postulates three basic psychological needs: a need for competence (i.e., to feel effective, skillful, and able to master the challenges of life), a need for autonomy (i.e., to feel that one causes, identifies with, and enjoys one's own behavior), and a need for relatedness (i.e., to feel close and accepted with important others and with important groups of others). The theory assumes that what varies between people is not how much the needs are needed, but rather, how well the needs are satisfied.

Considerable empirical work has supported SDT's "nutriments" conception, showing that autonomy, competence, and relatedness need satisfaction each make unique contributions in predicting many kinds of positive outcomes. This has been shown with respect to daily well-being (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000), "most satisfying events" (Sheldon, Elliot, Kim, & Kasser, 2001), secure relationship attachments (LaGuardia, Ryan, Couchman, & Deci, 2000), employee job satisfaction (Baard, Deci, & Ryan, 2004), student teacher-course evaluations (Filak & Sheldon, 2003), and more. The importance of feeling autonomous, competent, and related has also been shown in longitudinal analyses, in which the accumulation of these experiences over time predicts downstream positive outcomes (La Guardia et al., 2000; Sheldon & Elliot, 1999). Furthermore, and supporting the proposed

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universality of these three needs, these effects have been shown to occur in a wide variety of cultural contexts (Chirkov, Ryan, & Willness, 2005; Deci et al., 2001; Sheldon, Cheng, & Hilpert, 2011; Sheldon et al., 2001).

Need satisfaction and objective sports performance

However, the SDT needs research has been limited because it has focused mostly on predicting other subjective states besides need-satisfaction, such as positive mood (Sheldon & Elliott, 1999), appreciation of one's relationship partner (LaGuardia et al., 2000), liking of one's professor (Filak & Sheldon, 2003), and enjoyment of a sexual experience (Smith, 2007). We hoped to enlarge the evidence base for SDT's three needs by focusing on a more objective type of outcome, namely, sports performance. Why should psychological need-satisfaction predict sports performance? First, research has previously identified several psychological predictors of performance that are consistent with the SDT conception, such as self-efficacy (corresponding to competence), internal locus of control (corresponding to autonomy) and team unity (corresponding to relatedness). SDT may provide a useful conceptual framework in which to unify these findings. Second, SDT research has shown that need-satisfaction enhances many types of cognitive performance, including learning comprehension, depth of recall, and creativity. Since cognitive processes are involved in athletic performance (understanding the game situation, remembering tendencies of opponents), it is plausible that need-satisfaction enhances sports performance by this route. Third, SDT research has shown that need-satisfaction enhances intrinsic motivation and flow, factors already shown to promote higher quality performance in the sports domain (Ryan & Deci, 2007).

SDT does not assert that all needs affect all outcomes equally. How should the three proposed needs relate specifically to performance? We believed that pre-game competence satisfaction would predict positive game performance, again, because there are important overlaps between felt competence and felt self-efficacy (Conroy, Elliot, & Thrash, 2009), and because self-efficacy has often been shown to predict sport performance in the past (McCarthy, 2011; Wurtele, 1986). Of course, self-efficacy regarding a specific upcoming performance and feelings of general life-competence before the performance are not the same thing, but they are highly correlated (Diseth, Samuelsen, & Samdal, 2012; Peng, Lin, Pfeiffer, & Winn, 2012) and we believed that feelings of competence need-satisfaction should help produce positive expectancies that boost performance. We also hypothesized that pre-game autonomy satisfaction would predict game performance, because SDT's conception of autonomy encompasses states of intrinsic motivation and flow (absorption in the challenges of a task; Csikszentmihalyi, 1997), both of which have been shown to be related to sports performance in the past (Gillett, Berjot, & Gobance, 2009; Schuler & Brunner, 2009; Treasure, Lemyre, Kuczka, & Standage, 2007). We ventured no hypotheses concerning pre-game relatedness need-satisfaction predicting game performance, because "feelings of closeness with team-mates" have no direct logical relationship with individual basketball performance. For example, feeling very connected to teammates could conceivably undermine individual performance, if such feelings cause one to defer scoring opportunities to other players, or to flinch in one's own scoring opportunities for fear of failing and thus losing the connection.

How is game performance associated with subsequent need satisfaction?

Although we employed psychological needs primarily as *predictors* in this research, much SDT research has treated needs as *outcomes*, i.e. as something that is caused by contexts experienced, roles played, goals pursued, relationships entered, etc. (Kowal & Fortier, 2000; McDonough & Crocker, 2007; Sheldon, 2011). Because we measured need-satisfaction a second time, after the game, we could also address the traditional needs-as-outcomes issue. Specifically, we examined the associations of game performance upon pre–post changes in need-satisfaction. We hypothesized that positive game performance would boost post-game competence satisfaction, because doing especially well in a game should boost feelings of ability and mastery. We also hypothesized that positive game performance would boost post-game relatedness satisfaction, since one's teammates likely applaud and appreciate one's positive performance. In addition we hypothesized that positive game performance would boost post-game autonomy satisfaction, since successful players likely enjoyed the game and felt that their specific choices during the game had been justified.

Summary of hypotheses

We hypothesized that pre-game competence satisfaction and pre-game autonomy satisfaction would be associated with subsequent individual basketball performance, with no hypotheses for pre-game relatedness satisfaction. We tested the need-satisfaction to performance hypotheses in two orthogonal ways: by examining between-subject variations in average game need-satisfaction and average game performance, and by examining within-subject variations in specific game satisfaction and performance. We reasoned that confirming particular hypotheses using both types of analysis would provide particularly robust support for those hypotheses. We also hypothesized that game performance would predict enhanced satisfaction of all three of the basic needs, a prediction which was also tested both between- and within-subjects, to examine the prediction's robustness.

Method

Participants and procedure

Initial participants were 68 players in a four game recreational basketball league offered at a large public university in the Midwest, 46 men and 22 women. Fifty-nine were Caucasian and all were between 19 and 22 years old. They were recruited via personal contacts with team coaches or representatives, or by emails sent to team coaches/representatives via a university listserv. Willing coaches asked their players if they would participate in the study, and eight different teams and their players agreed (although not all players on all teams agreed). A research assistant attended 26 games in all (six games of the 32 possible were not played because of forfeits). None of the games involved study teams matched against each other. Each player was assigned a unique ID number so that their data could be linked across games. Prior to each game, players completed the need-satisfaction measure (described below), and they also completed a similar need-satisfaction measure at the conclusion of the game. The games were played with a clock and a referee. During the game the third author kept data on the number of three point shots taken, the number of two point shots taken, and the number of foul shots taken by each player, as well as the outcome of these attempts.

Measures

Need satisfaction

The BMPN (Sheldon & Hilpert, 2012) consists of 18 items. Because team coaches were concerned with overburdening athletes before games, as a condition of conducting the study we agreed to reduce the scale to 12 items, four for each need. The six omitted items were those deemed least relevant to the sports

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Table 1
Descriptive information on study variables.

	Mean	SD	Min.	Max.	ICC[a]	α[b]
Pre-game measures						
Autonomy satisfaction	1.87	1.21	−1	4.00	.65	.79
Competence satisfaction	1.59	1.35	−1.67	4.00	.61	.77
Relatedness satisfaction	3.19	.90	0	4.00	.61	.76
Post-game measures						
Autonomy satisfaction	1.85	1.23	−.75	4.00	.41	.60
Competence satisfaction	1.08	1.51	−2.33	4.00	.49	.67
Relatedness satisfaction	3.07	.14	0	4.00	.26	.44
Performance measures						
1 taken	1.40	1.70	0	8.00	.53	–
2 taken	4.02	2.48	0	10.00	.42	–
3 taken	2.21	2.81	0	13.00	.67	–
1 percentage	30.29	32.68	0	100	.49	–
2 percentage	32.22	24.78	0	100	.01	–
3 percentage	13.10	17.21	0	50.04	.30	–
Total points	5.60	5.26	0	25.00	.56	–

Note: $N = 59$. All descriptive information was based on individual's averaged scores across 4 games, except ICC.
[a] Intra-class correlation.
[b] The reliability of the random effect of level-1 intercept is the average reliability of the individual.

performance context (e.g., for autonomy satisfaction, the item "my choices expressed my true self" was omitted). We also modified the items slightly to fit the basketball context. For example, "I feel unappreciated by one or more important people," a negatively-worded relatedness item, was modified to "I feel unappreciated by one or more teammates," and "I am free to do things my own way," an autonomy item, was modified to "I feel free to play how I want." The questionnaire was administered both before and after the game, with some items reworded to the past tense for the second questionnaire. A 1 (not at all) to 5 (very much) scale was used. Six subscale scores were computed, three for the pre-game and three for the post-game measures. As an unfortunate consequence of using short version of the measures (for the reasons explained above) and relative small level-1 sample size, one of these scores had average reliability of the level-2 units (Bryk & Raudenbush, 1992, pp. 39–40) of less than .50, whereas the other five were above .60 (see Table 1 for more details). Nevertheless we proceeded to test our hypotheses, reasoning that the observed associations might underestimate the true associations.

Objective game performance

Objective game performance was measured by seven variables. Of course, many points cannot be scored unless many shots are taken (Tversky & Gilovich, 2004). Thus three of the variables represented the "quantity" of shooting: the number of three point shots taken, the number of two point shots taken, and the number of foul shots taken by each player. We also computed shooting percentages for each type of shot by dividing the number of shots made by the number of shots taken. These three variables represent the "quality" or efficiency of shooting. As a seventh performance variable we examine total points scored which reflect the scores from three point shots, two point shots and foul shots. Although this variable combines both quantity and quality information, it is the real-world statistic that is most scrutinized and discussed by sports fans.

Results

Data analytic strategy

Data in the present study were structured hierarchically, with repeatedly measured needs satisfaction and game performance (L1) nested under individual player (L2). Multilevel modeling (MLM) was adapted for all analyses by using the Proc Mixed procedure in SAS (Singer, 1998). Even though we were not interested in testing any growth effects in the current study, multilevel modeling is still particularly suited for analyzing these data because it can effectively manage missing data on the repeated measure (e.g., some player missed one of the four games) and can adjust for any bias in standard errors and statistical tests resulting from the non-independence of observations (Kenny, Korchmaros, & Bolger, 2003; Krull & MacKinnon, 2001). In the current study, a random intercept model was adopted for all analyses allowing the mean score of the outcome to vary randomly across L2 units (i.e., persons). All analyses were conducted with restricted maximum likelihood models. The influential outliers and distribution of each outcome was checked first and squared root transformation was used for two outcomes due to the moderate positively skewed distributions (e.g., three point shots taken and three point percentage made; after transformation, skew and kurtosis were both less than one for both variables). In the current study, we did not attempt to account for the 3-level structure of games nested in players nested in teams, because intraclass correlations by team were small and because we had no team-level hypotheses or predictors.

Data analyses in the current study included between-person analyses and within-person analyses. In the between-person analyses sections, we examined whether individual differences in pre-game needs satisfaction, averaged across four games, predicted individual's average game performance, measured in terms of shots taken and shooting percentages. We entered the three pre-game needs satisfaction variables simultaneously in the same models so that the unique contribution of each predictor upon the outcomes could be evaluated. We also examined whether individual differences in averaged performance across four games predicted differences in averaged post-game needs satisfaction, controlling for averaged pre-game need satisfaction. In this set of analyses, predictors (e.g., average pre-game needs satisfaction or average performance) were computed by aggregating across four game reports for each player, and then centered around their own means and modeled at L2 in the model. Gender was included in all analyses as L2 covariate. Thus the coefficients of L2 predictors reflect the effects of a person's deviations away from the sample mean in predicting deviations away from the sample mean for the outcomes. For example, the following model was used to test the effects of individual's average pre-game needs satisfaction (L2) on his or her game performance (L1):

$$\begin{aligned}\text{Performance}_{ij} = {} & \gamma_{00} + \gamma_{01}(\text{Autonomy Satisfaction})_j \\ & + \gamma_{02}(\text{Competence Satisfaction})_j \\ & + \gamma_{03}(\text{Relatedness Satisfaction})_j \\ & + \gamma_{04}(\text{Gender})_j + r_{ij} + u_{0j} \qquad (1)\end{aligned}$$

where "Performance$_{ij}$" is the level of performance for game i of person j; γ_{00} is the predicted mean level of performance for person j when all other variables in the model equal zero; γ_{01}, γ_{02} and γ_{03} represent the effects of person j's averaged pre-game needs satisfaction compared with other players on person j's performance; γ_{04} represents the effect of person j's gender on performance; and r_{ij} and u_{0j} are the random residuals for the game i and person j.

In the within-person analyses sections, we examined whether within-person fluctuations in pre-game needs satisfaction predicted within-person changes in game performance by entering three L1 pre-game needs satisfaction simultaneously in each model; we also examined whether within-person fluctuations in game performance predicted within-person changes in post-game

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Table 2a
Unstandardized coefficients predicting averaged game performance from averaged pre-game need satisfaction.

	1 points taken	Percent of 1	2 points taken	Percent of 2	3 points taken	Percent of 3	Total points
	b. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)
Autonomy sat	.26 (.16)	5.57 (3.30)$^{+}$	.72 (.29)*	6.61 (2.60)**	.02 (.11)	−.01 (.03)	.99 (.60)$^{+}$
Competence sat	.25 (.15)$^{+}$	3.27 (3.09)	.15 (.27)	−.44 (2.43)	.27 (.10)**	.07 (.03)**	1.14 (.56)*
Relatedness sat	−.48 (.22)*	−10.5 (4.57)*	−.55 (.40)	−4.83 (3.72)	−.21 (.15)	−.03 (.04)	−1.66 (.83)*

Note. Each column represents a single analysis in which the column variable was predicted by the three row variables. $+p < .10$, $^{*}p < .05$, $^{**}p < .01$.

needs satisfaction by entering one L1 game performance variable and controlling for pre-game needs satisfaction in each model. In this set of analyses, L1 predictors (e.g., pre-game needs satisfaction or game performance) were group mean centered, so effects reflect changes in each outcome compared with participants' own average levels across four games on that outcome, as a function of changes in their predictors compared with their own average levels of predictors (Bryk & Raudenbush, 1992; Enders & Tofighi, 2007; Hofmann & Gavin, 1998). For example, the following model was used to test the within-person fluctuations in pre-game needs satisfaction (L1) predicting within-person changes in game performance (L1):

$$\begin{aligned}\text{Performance}_{ij} = {} & \gamma_{00} + \gamma_{10}\left(\text{Autonomy}_{ij} - \overline{\text{Autonomy}_{j}}\right) \\ & + \gamma_{20}\left(\text{Competence}_{ij} - \overline{\text{Competence}_{j}}\right) \\ & + \gamma_{30}\left(\text{Relatedness}_{ij} - \overline{\text{Relatedness}_{j}}\right) \\ & + \gamma_{01}(\text{Gender})_{j} + \text{r}_{ij} + u_{0j} \qquad (2)\end{aligned}$$

where γ_{10}, γ_{20} and γ_{30} represent the predictive effects of the deviations of person *j*'s needs satisfaction before game *i* away from his or her mean needs satisfaction before games on person *j*'s performance; and γ_{01} represents the effect of person *j*'s gender on performance. The remaining terms are defined in a manner analogous to Eq. (1).

Results

Preliminary analyses

Among the 68 participants recruited, there were nine cases in which a participant did not take any shots at all during a game. In most of these cases the participant played very little, so we eliminated these instances, leaving 59 persons offering data points on 150 games in the final sample. These nine instances did not differ from the remaining instances in any of the preliminary need-satisfaction variables. For analyses on post-game needs satisfaction as outcomes, 142 data points rather than 150 were used, due to some missing post-game data. Table 1 contains descriptive statistics for the major study variables aggregated on the person level (L2). As can be seen, most variables had ICCs larger than .50, indicating substantial person-level variability in the data. In addition, bivariate correlations between person level variables indicated that the numbers of foul shot, two point and three point shots taken were highly correlated with the number of foul, two point and three point shots made, *r*s > .78. This is logical since the amount of scoring is highly dependent on the amount of shooting (Tversky & Gilovich, 2004). Therefore, the number of foul shots made, two point shots made and three point shots made are not shown below; instead, shooting percentages are reported. The three need satisfaction measures were inter-correlated between .30 and .35 in the pre-game assessment, and between .35 and .52 in the post-game assessment (not shown).

Primary analyses

Predicting performance: between-person analyses

Table 2a presents the unstandardized coefficients predicting game performance from individual's average level of needs satisfaction before games. As can be seen, autonomy satisfaction was a significant or marginally significant predictor of foul shot shooting percentage, the number of two point shots taken, two point shooting percentage, and the total points scored in the game. Competence satisfaction significantly or marginally significantly predicted the number of foul shots taken, the number of three point shots taken, three point shooting percentage, and total points scored. Thus, our hypotheses concerning the positive association of autonomy and competence need satisfaction with performance received support.

One unexpected pattern emerged in these data. Higher level relatedness satisfaction before the game predicted fewer foul shots taken, a lower percent of foul shots made, and fewer total points in the game. This finding is puzzling, because it suggests that the individuals who generally feel positively connected with one's teammates before games may perform worse both in quantity (foul shots taken) and quality (foul shot percentage) of performance, compared with those who generally feel less connected with their teammates before game. Possible reasons for this finding will be considered in the Discussion section.

Predicting performance: within-person analyses

We then examined the predictive effects of within-person fluctuations in pre-game needs satisfaction on within-person changes in game performance. As showed in Table 2b, no significant results were found, failing to support our hypotheses.

Taken together, the results in Tables 2a and 2b suggest that stable individual differences in autonomy, competence, and relatedness need satisfaction before the game significantly predict person's averaged performance levels. People who generally feel more autonomous and competent, or less related, before a game

Table 2b
Unstandardized coefficients predicting variations in game performance from variations in pre-game need satisfaction.

	1 points taken	Percent of 1	2 points taken	Percent of 2	3 points taken	Percent of 3	Total points
	b. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)
Autonomy sat	−.09 (.16)	3.74 (3.54)	−.05 (.32)	3.10 (4.18)	−.06 (.08)	.01 (.04)	.04 (.52)
Competence sat	.14 (.12)	3.96 (2.63)	−.18 (.23)	−5.12 (3.10)$^{+}$	.06 (.08)	−.01 (.03)	−.55 (.39)
Relatedness sat	−.13 (.19)	−2.55 (4.27)	.10 (.39)	−1.16 (5.04)	−.09 (.10)	.03 (.04)	.09 (.64)

Note. Each column represents a single analysis in which the column variable was predicted by the three row variables. $+p < .10$.

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Table 3a
Unstandardized coefficients predicting averaged post-game need satisfaction from averaged game performance.

	1 points taken	Percent of 1	2 points taken	Percent of 2	3 points taken	Percent of 3	Total points
	b. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)
ΔAutonomy sat	.10 (.05)*	.004 (003)	.01 (.04)	.01 (01)	.02 (.03)	01 (.01)	.01 (.02)
ΔCompetence sat	.14 (.09)	.01 (.005)*	.06 (.06)	.01 (.01)+	.11 (.06)+	.02 (.01)**	.08 (.03)**
ΔRelatedness sat	.11 (.05)*	.01 (.002)*	.04 (.04)	.00 (.01)	.01 (.03)	−.002 (.01)	.02 (.02)

Note. Each cell represents a single analysis in which the post-game satisfaction variable was predicted by the column variable, controlling for the pre-game version of the satisfaction variable. $+p < .10$, $^{*}p < .05$, $^{**}p < .01$.

perform better than those who feel less autonomous, less competent, or more related. However, people's fluctuating levels of need satisfaction prior to specific games do not impact their subsequent performance in those specific games.

Predicting changes in need-satisfaction variables: between-person analyses

We then treated psychological need-states as outcomes, rather than as predictors (Sheldon, 2011), testing how average game performance variables impact post-game need satisfaction when pre-game needs satisfaction were controlled. There were 21 separate analyses entailed by the combination of the three need measure outcomes (autonomy, competence, and relatedness satisfaction) and the seven performance measures (one, two and three point shots taken and the percentages made of each, and also overall points). As shown in Table 3a, competence satisfaction was significantly or marginally significantly boosted by five different predictors (foul shot shooting percentage, two point shooting percentage, the number of three point shots taken, three point shooting percentage, and total points). Relatedness satisfaction was boosted by the number of foul shots taken and the percentage of foul shots made; and autonomy satisfaction was only boosted by the number of foul shots taken.

Predicting changes in need-satisfaction variables: within-person analyses

Finally we investigated the effects of within-person fluctuations in game performance on within-person changes in needs satisfaction. Similarly as the description above, 21 separate analyses were conducted. As shown in Table 3b, and consistent with the between-person effects shown in Table 3a, competence satisfaction after a certain game was significantly boosted by foul shot shooting percentage, two point shooting percentage, three point shooting percentage, and total points scored. In addition, relatedness satisfaction after certain game was also significantly boosted by two point shooting percentage and total points scored. Game performance had no significant associations with post-game autonomy need-satisfaction.

Taken as a whole, the results in Tables 3a and 3b suggest that feelings of competence and feelings of relatedness are influenced by good game performances, both at the between-subjects and the within-subjects levels. It is also noteworthy that the best predictors of boosted need-satisfaction were the shooting percentage variables, not the number of shots taken variables. This suggested that an efficient or high "quality" performance is more impactful than a high "quantity" performance, in which a person shoots a lot but does not necessarily make many of those shots.

Discussion

In this article we present a novel study of the association of psychological need-satisfaction with sports performance, specifically, basketball performance. We reasoned that since satisfied psychological needs support people's intrinsic motivation, positive mood, and cognitive efficiency (Ryan, 1995), then they should perhaps facilitate the objective quality of player's motor performances, not just the subjective quality of the player's experiences. We found good support for this basic idea. To summarize the results: Pre-game autonomy and pre-game competence need-satisfaction both predicted several aspects of objective game performance. Pre-game autonomy predicted more two point shots taken and a higher percentage of two point shots made, a higher percentage of one point (foul) shots made, and more total points. Pre-game competence satisfaction predicted more one point and three point shots taken, a higher percentage of three point shots made, and more total points. Thus, it appears that competence need-satisfaction may fuel a greater "quantity" (shots taken) of performance, and autonomy need-satisfaction may fuel a greater "quality" (efficiency) of performance. Possible reasons for this will be discussed below.

Interestingly, however, these predictive patterns did not emerge at the within-subjects level of analysis. Thus, feeling *particularly* competent or autonomous before a particular game did not forecast a particularly good performance, and nor did low need-satisfaction forecast a particularly bad subsequent performance. Thus it appears that although psychological need-satisfaction might influence performance in general, momentary need-satisfaction (above or below usual) may not be as impactful. Unfortunately we cannot explain the reasons for this discrepancy with the current data.

Turning to needs-as-outcomes, we found that a high quality of game performance, more so than a high quantity of performance, predicted enhanced competence and relatedness need-satisfaction after the game. Players who merely took many shots without making very many of them did not experience as many benefits. These patterns emerged at both between- and within-subject levels of analysis, indicating that being a good player makes one

Table 3b
Unstandardized coefficients predicting variations in post-game need satisfaction from variations in game performance.

	1 points taken	Percent of 1	2 points taken	Percent of 2	3 points taken	Percent of 3	Total points
	b. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)	*b*. (SE)
ΔAutonomy sat	.02 (.07)	.01 (00)	−.02 (.05)	.00 (00)	.03 (.07)	.01 (.004)	.04 (.03)
ΔCompetence sat	.07 (.09)	.01 (.01)*	−.02 (.06)	.01 (.00)**	.13 (.08)	.02 (.005)**	.13 (.03)***
ΔRelatedness sat	.02 (.07)	.00 (.00)	.02 (.05)	.01 (.00)*	.08 (.06)	.00 (.00)	.06 (.03)*

Note. Each cell represents a single analysis in which the post-game satisfaction variable was predicted by the column variable, controlling for the pre-game version of the satisfaction variable. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

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feel competent and connected not only in general, but also, after particularly good performances. In contrast, game performance apparently did not predict feelings of post-game autonomy. It remains for future research to determine whether autonomy is affected by a different set of game or performance variables than those measured herein.

Relatedness and performance

Below, we consider several further questions raised by these findings. First, why did pre-game relatedness satisfaction predict *fewer* one point shots taken, a *lower* shooting percentage for such shots, and fewer points scored overall? The fact that the differences emerged primarily for foul shots suggests that feelings of connectedness with team-mates might cause a player to play less aggressively or assertively in the games, given that getting to shoot foul shots often requires driving hard to the basket. Feeling very accepted and appreciated by one's teammates might also reflect a player's role as a team coordinator or distributor of shots to others, factors which might also cause the player to hesitate to take charge. Unfortunately, these possibilities cannot be addressed with the current data. Still, our data suggest that at the start of a game, athletes should be thinking more about how they expect to enjoy the game and do well in it, and less about how close they are feeling with their teammates.

Autonomy, competence, and performance

Why was autonomy the stronger predictor of "quality" of performance (percent of one and two point shots made), and competence the stronger predictor of "quantity" of performance (number of one and two point shots taken)? Deci and Ryan (1985) have distinguished between autonomy and self-efficacy by saying that self-efficacy is typically associated with a strong *quantity* of motivation, but the *quality* of that motivation is unspecified (note that here we are talking about quantity and quality of motivation, not performance). An athlete entirely driven by money (low quality motivation, from the SDT perspective) might still have strong self-efficacy – even a slave might feel efficacious in completing his or her onerous duties. In contrast, autonomy directly concerns the quality of motivation – is one playing for the love of the game, for the challenge of winning? Or, is one playing under the influence of some kind of duress, or with some extra-game contingency in mind? Much research supports the idea that feeling autonomous produces better performance, especially performance in "heuristic" tasks (Amabile, 1996) that are free flowing (Csikszentmihalyi, 1997) and cannot be broken down into preset algorithms or programs. Although the game of basketball of course involves some set plays and strategies, the highest quality play is often improvisational, even akin to jazz (Berkowitz & Ansari, 2008). Perhaps this level of play requires feelings of freedom and volition (i.e., autonomy).

Do not uncritically aggregate three need-satisfaction measures into one

A common research practice in the SDT literature is to combine measures of autonomy, competence, and relatedness need-satisfaction into a single aggregate, and call it "overall need satisfaction." Although this can be defensible in some cases, researchers also stand to lose information from this practice. According to Basic Psychological Needs theory (Deci & Ryan, 2000; Ryan, 1995; Ryan & Deci, 2008), the three needs are three distinct psychological "nutrients" just as vitamins A, B, and C are distinct physical nutrients. Failing to consider them separately may cause researchers to overlook important distinctive causes or outcomes of the needs, such as those reported in this article. Notably, in the current research, in one ancillary set of analyses, we combined all three pre-game need-satisfaction measures into a single "overall need satisfaction" composite. In these analyses aggregate need-satisfaction was unrelated to game performance, either between- or within-subjects, and there would be no story if we had stopped there. We realize that for some outcomes, like psychological well-being, all three needs are expected to have independent associations with outcomes, and that combining the three needs thus yields the greatest power to predict those outcomes. However, we urge researchers not to do this automatically or unthinkingly.

Limitations

This study has a number of important limitations. First, the relatively small sample of participants and sample of games limits power, especially the small number of games played during the recreational league season. This means that the pattern of within-subject variations in satisfaction and performance was being estimated by relatively few data points. Still, our ability to detect the predicted within-subject effects in the needs-as-outcomes analyses suggests that this problem should not be overstated. Second, the shortened need-satisfaction questionnaire employed was not as reliable as a longer version would be, because we were unable to burden the athletes with longer questionnaires right before their games. Still, our ability to detect predicted associations again suggests that this was not a fatal flaw. Third, the sample of student participants is not as desirable a sample of professional or varsity athletes would be, at least for understanding truly elite performance. However, there is no obvious reason why results from studies of non-elite level players should not be generalizable to elite-level players. Indeed, the associations might be even more pronounced at elite levels; Sheldon and Watson (2011) showed that although having an autonomy-supportive coach was important for recreational and club-level athletes, it was *especially* important for elite-level varsity athletes. Fourth, this was a single study, and requires replication using other samples, other seasons, and even other sports. Fifth, our conclusions are not causal and experimental evidence is needed, perhaps adduced by manipulating the three needs (Sheldon & Filak, 2008). Finally, other possible psychological predictors of performance, such as expectancies or performance appraisals, were not measured. Some of the need-satisfaction effects might be explainable by, or reducible to, alternative constructs. However, questionnaire space precluded such consideration.

In conclusion, the current study shows in a new way that an athlete's psychological state, particularly feelings of competence and autonomy, is associated with his or her sports performance. However, this appears to be primarily true of the player's general state, and not within-subject fluctuations in that state. The study also shows that high quality performance in turn predicts boosted need-satisfaction, particularly competence and relatedness satisfaction. The latter associations were found in both between-subject and within-subject analyses. We hope that other researchers will attempt to replicate and extend these findings, to other sports, regions, and levels of play.

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